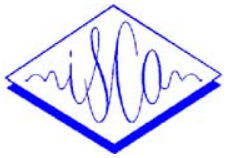

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VOWEL PRODUCTION IN APHASIA

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SUMMARY

This study explored a voice characteristics in aphasic patients suffering from the damage of the left and right cerebral hemispheres regardless of the aphasia type. A series of acoustic analyses were conducted including fundamental frequency in Hz (Fo), duration of the vowel "a" phonation, jitter and shimmer. A pattern of 20 male aphasic patients was included in the research.
At the aphasics with the damage of the right cerebral hemisphere means show higher value of the basic laryngeal tone (Fo) but shorter fonation. Respondents with aphasia caused by a left hemisphere damage achieved better scores on variable duration of the vowel "a". It seems that disorder in aphasics with right lesion primarily reflects an inability to implement particular types of articulatory gestures or articulatory parameters rather than an inability to implement particular vowel.

INTRODUCTION

Voice disorder in aphasics is often connected with motor types of aphasia. Many authors [8], [4] consider dysphonia as a component of motor speech disorders characterised by reduced loudness, inspiratory stridor, breathy and harsh phonation and diplophonia. Several studies [12], [5], [15] observed acoustic measurement of VOTs for voiced and voiceless target sounds (consonants) produced by Broca's and Wernicke's aphasics. Most recent acoustic/ phonetic research has demonstrated that Broca's aphasic generally display articulatory implementation deficits, whereas Wernicke's aphasic exhibit deficits in phonological planning [5], [6], [17]. In particular, acoustic analyses have shown that anterior patients have problems with the temporal control of articulatory gestures, especially those requiring the coordination of two independent articulators, e.g., the larynx and tongue or lips in the production of voicing in stop consonants, and the velum and the tongue or lips in the production of nasal consonants [5], [6], [14]. Wernicke's aphasics, in general, do not show such deficits. All of these researches have been focused on prosody and difficulties in articulator coordination at pronunciation of certain voice groups (consonant-vowel). However, there are few researches and available results about voice disorders at aphasics. Therefore the aim of these research has been to determine phonation differences between left and right brain damage patients regardless of the aphasia type.

METHOD

SUBJECTS

A total of 20 male aphasic patients served as subjects (X=42,5). They were clinically diagnosed on basis of Boston Diagnostic Aphasia Examination [9]. The lesion site was established by neurological findings (computerized tomography-CT or magnetic resonance-MR), and the respondents were divided into left hemisphere (10) and right hemisphere (10) damaged aphasics.

VARIABLES

The research was based on five variables. As a criterion we used the variable of brain damage location. The other four variables are based on the results of each sample analysis.

Brain damage location

According to the neurologist diagnoses the subjects were divided into two groups: aphasics with left side brain damage and aphasics with right side brain damage.

Fundamental frequency

Fundamental frequency is a number of vibration produced by vocal cords in one second measured in hertzs (Hz). Higher number of vibrations signifies higher fundamental frequency value so the voice sounds higher.

Vowel "a" duration

When producing the vowel "a" the respiratory and glottis muscles are not very tense. At the articulation of the vowel "a" it is necessary only to relax the lower jaw. The hioglosus muscle drags the tongue downwards and towards the pharynx so that the space in the front half of the mouth becomes wider and in pharynx it becomes narrow.

Jitter

The term describes irregularity in vocal cords vibration and in hesitation of the fundamental frequency. In vowels sustained by healthy speakers jitter is typically 0.1 to 1% of the average cycle length [11]. Higher jitter values diminish the voice quality.

Shimmer

Shimmer determs intensity irregularities of each vocal cord vibration measured in dB. Higher shimmer value

in speakers results in hoarse voice. Average shimmer values are between 0.04-0.21 dB [7].

TASKS

We were interested for differences of voice characteristics at aphasic patients suffering from the damage of the left and right cerebral hemispheres. The task of the patients was to produce the vowel "a" as long as possible. The examiner demonstrated the phonatory task to each patient. The subjects were seated in a sound - treated room, and their voices were recorded on an audio tape. The microphone (Sennheiser, ME 66) was placed 40 cm from the subject's lips.

The acoustic analysis is performed by using voice analysis software EZVOICE V.1.2.

The differences in variables between the subject groups were analysed by t-test for independent samples. The data was processed on PC computer program Statistic for Windows, Realise 6.1.

RESULTS

The basic statistical parameters, mean, standard deviation and minimum and maximum results are shown in Table1. The examination and comparisons of means and standard deviations of results did not reveal significant differences ($p < 0.05$) between the measured variables.

Table 1. Descriptive statistics

VARIABLES	MEAN	STD. DEV.	MIN.	MAX
AGE	42.50	13.33	18.00	56.00
FUNDAMENTAL FREQUENCY	245.85	69.91	136.00	316.00
FONATION TIME	9.58	5.98	2.00	19.00
JITTER	4.02	1.35	1.10	6.38
SHIMMER	1.37	0.19	0.98	1.62

Means and standard deviations of the duration's of the vowel "a" were computed for each aphasic subject group. These value are displayed in Table 2. T-test result shows differences only at duration "a" variable. Right brain damege aphasic patients hawe higher results witch correlated with duration of vowel "a".

It is well known that aphasia can destroy the voice itself. The vowels could be disorded but they are rarely changed for another vowel [18], [16]. It seems that vowels as the singing part of the speech and bearer of the speech melody are not influenced by aphasia.

Table 2. Results of T-test for criterion variable of brain damage location

VARIABLES	RIGHT mean	LEFT mean	T-test	df	p
FUNDAMENTAL FREQUENCY	269.87	220.30	-1.012	10	.342
FONATION TIME	6.850	15.617	3.612	10	.004
JITTER	3.681	3.542	-.211	10	.902
SHIMMER	1.325	1.378	.488	10	.659

Recent studies [3] explored a number of durational parameters of consonant and vowel production in order to determine whether the speech production impairments of aphasic are the result of the same or different underlying mechanisms and whethever these implicate deficits that are primarily phonetic or phonological in nature. A series of acoustic analyses were conducted and produced by Broca's aphasic with anterior lesion, nonfluent aphasic with anterior and posterior lesions and fluent aphasic with posterior lesions. The constellation of impairments for the anterior aphasic suggests that their disorder primarily reflects an inability to implement particular types of articulatory gestures or articulatory parameters rather then an inability to implement particular phonetic features. They display impairments in the implement of laryngeal gestures for both consonants and vowel production. These pattern seems to relate to particular anatomical sites involving Broca's area, the anterior limb of the internal capsule, and the lowest motor cortex areas for larynx and tongue.

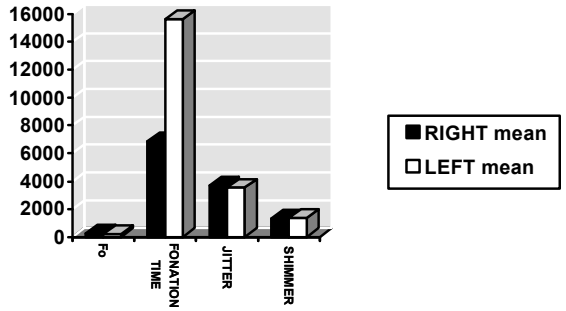
CONCLUSION

Expected accustical voice analysis differences in aphasic patiens with different brain damage localisation have not been statistically confirmed. Aphasic patiens with right brain lesion had higher fundamental frequency values and statistically shorter vowel "a" duration. Acoustic analysis although subjective points to a silent, noisy and shorter vocalisation at all aphasic patients, which was proved by many authors [1], [13]. However it should be emphasised that tremor more often occurs at the subjects who suffered from the damage of the left cerebral hemisphere.

Brain hemispheres are different according to their functions. In most people the left hemisphere is responsible for reasoning, logic, speech, language and analysis [10]. The right hemisphere is associated with face and object recognizing, visual patterns, rhythm, voluntary movement control, as well as with the

perception of space, creativity, musical melodies and humor. We can assume that this functions have also been disorted in subjects with right brain lesion, what has resulted in longer vowel "a" duration in left brain damage subjects.

Histogram 1. Differences between right and left brain damage aphasic patients



The problem of voice disorder which is certainly a part of aphasic patients has not been investigated enough either in Croatian or in foreign literature. The aim of this paper is to point out the need to recognise and diagnose the voice disorder at aphasic patients in time, and to include voice therapy in the entire rehabilitation of aphasic patients.

Spectrogram 1. Characteristical voice pattern of left brain damaged subjects (discontinued voice)

Spectrogram 2. Characteristical voice pattern of right brain damaged subjects (continued voice)

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